NASA TECH BRIEF

Method of Making Conical Fiber Optical Components

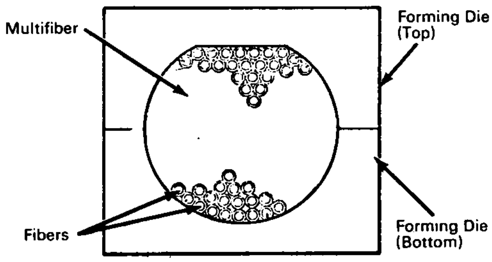

FIGURE 1

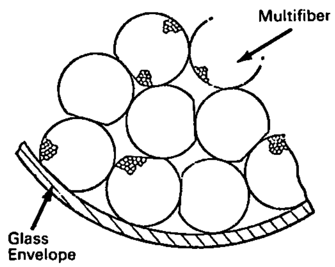

FIGURE 2

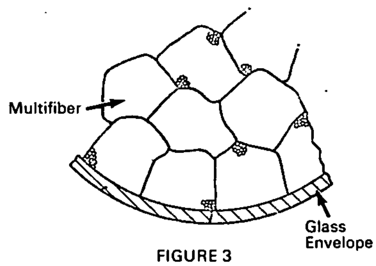

FIGURE 3

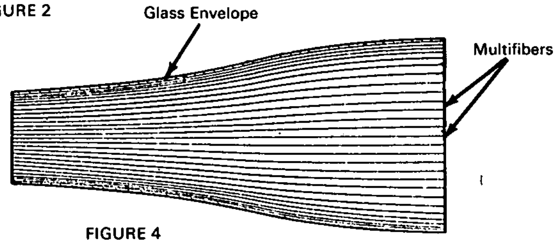

FIGURE 4

An improved method has been devised for the production of fused-fiber optical components. These components have a frusto-conical shape and provide high-quality light transmission with high resolution capabilities. The light pattern or luminous image transmitted through a frusto-conical component is enlarged or reduced in size, depending upon the direction of light through the component. These fiber optical components can be used in various precision optical systems, such as in certain camera applications.

The fibers for the optical components are drawn from glass rods which are coated with a light transmitting material usually having a refractive index considerably lower than that of the glass rod itself. As a consequence, essentially all of the light entering one end of a fiber fabricated from a coated glass rod tends to be confined (by reflection from the coating) to the fiber and passes out the other end.

A large number of the coated small-diameter fibers are positioned side-by-side in a pair of mating dies (Figure 1), in which the fibers are fused together and

(continued overleaf)

drawn into an elongated fiber of larger diameter called a multifiber. The dies define essentially a circular cross section, but with the upper wall of the top die flattened. The multifiber therefore takes the form of a truncated circular cross section. The flat surface of the multifiber engages an alignment mechanism during the drawing process to prevent twisting during processing. The multifiber is cut into sections of the desired length to form a number of multifibers. These multifibers are positioned side-by-side in a tubular glass envelope, as shown in Figure 2. The multifibers and surrounding envelope are heated and softened progressing along the length of the envelope to cause the envelope and the multifibers to fuse and collapse inwardly to fill the voids between the multifibers (Figure 3). During this process, a vacuum is applied to the envelope to exhaust any gases displaced or produced by the collapsing fibers. While the fused unit is still heated to a temperature below the softening point, but above the annealing point, additional heat is added, with the greatest temperature being applied to the midsection of the fused unit. Tension is then applied to the ends of the unit to stretch it into two frusto-conical sections. When the desired reduced diameter is obtained, the unit is cooled according to a rigorous annealing schedule, after which the two sections may be separated by the use of a diamond-edged saw or other suitable means. One of the completed sections is shown in Figure 4.

Note:

Documentation is available from:
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Patent status:

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